FIG. 1

TRACKING ERROR SIGNAL ANALYSIS

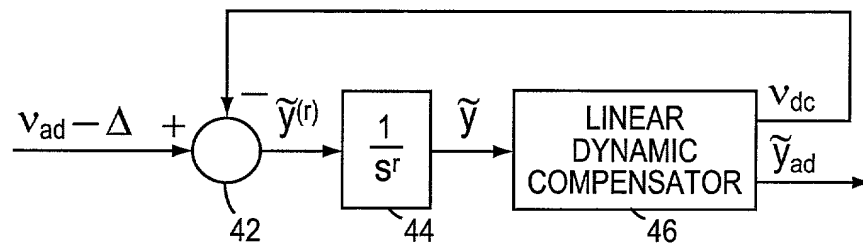
$$\nu_{ad} - \Delta \xrightarrow{} \underset{42}{+} \bigcirc \xrightarrow{-\ \tilde{y}^{(r)}} \boxed{\dfrac{1}{s^r}}_{44} \xrightarrow{\tilde{y}} \boxed{\begin{array}{c} \text{LINEAR} \\ \text{DYNAMIC} \\ \text{COMPENSATOR} \end{array}}_{46} \begin{array}{l} \nu_{dc} \\ \tilde{y}_{ad} \end{array}$$
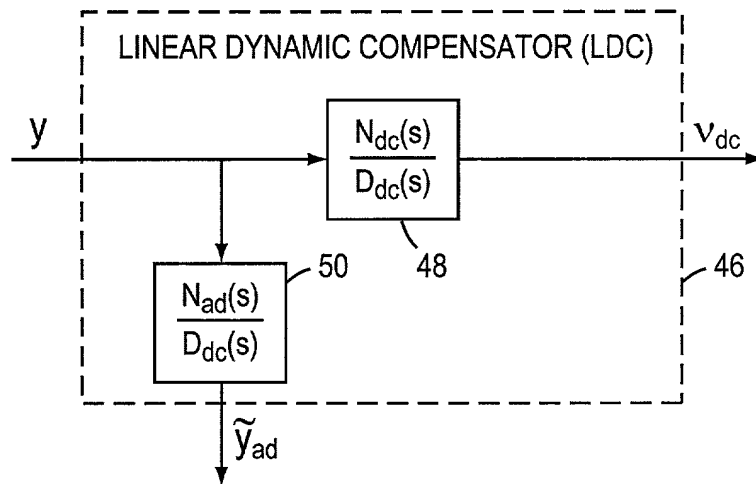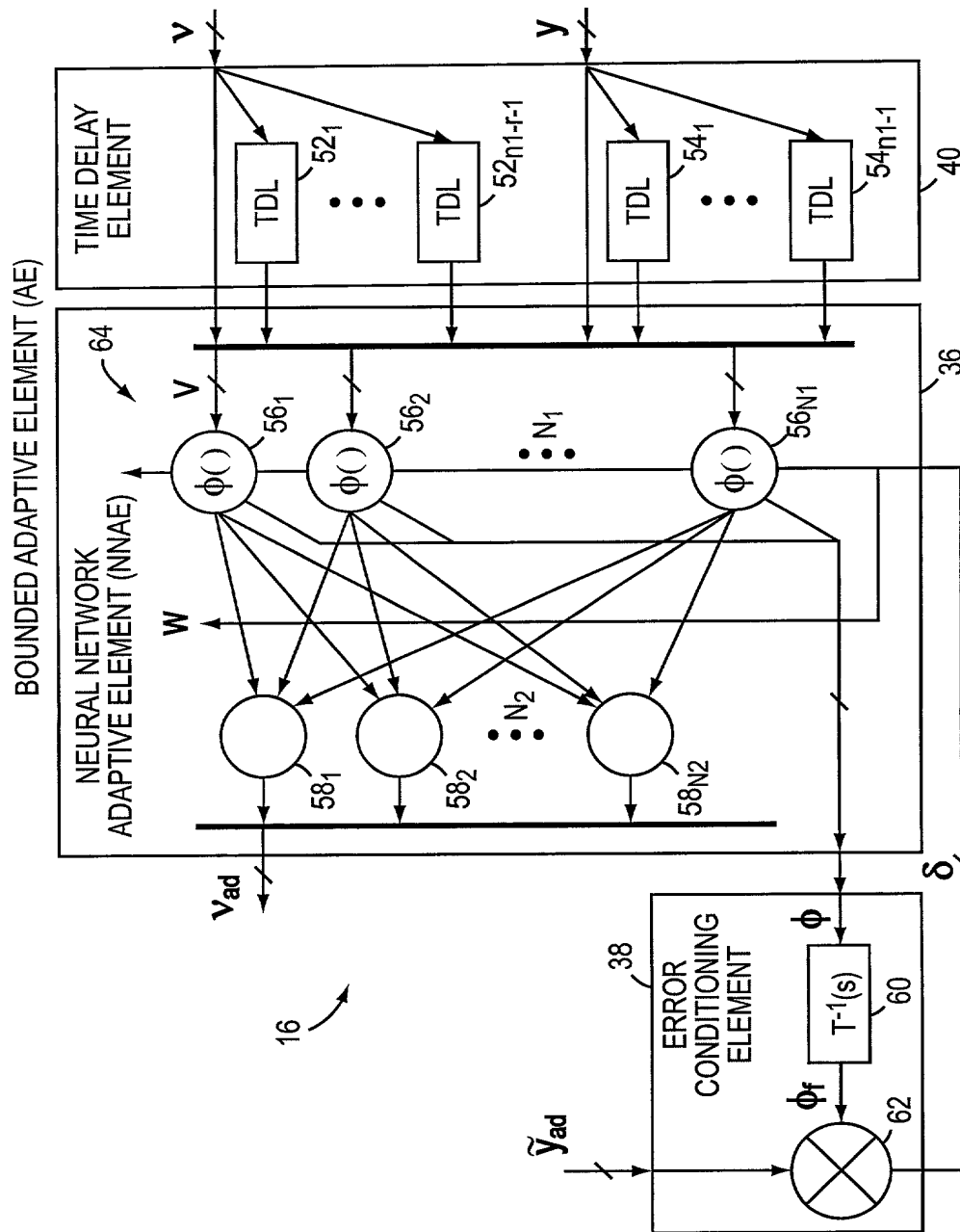
FIG. 2

FIG. 3

FIG. 4

PROCESSOR-BASED ADAPTIVE CONTROL SYSTEM
USING DIRECT OUTPUT FEEDBACK

FIG. 5

START — S1

GENERATING COMMAND CONTROL SIGNAL δ_c BY INVERTING AN APPROXIMATE MODEL OF PLANT DYNAMICS, BASED ON PSEUDO-CONTROL SIGNAL ν AND PLANT OUTPUT SIGNAL y — S2

SUPPLYING THE COMMAND CONTROL SIGNAL δ_c TO CONTROL THE PLANT — S3

GENERATING A PLANT OUTPUT SIGNAL y — S4

GENERATING A TRACKING ERROR SIGNAL $\tilde{y}$ BY DIFFERENCING CORRESPONDING SIGNAL COMPONENTS OF THE COMMANDED OUTPUT SIGNAL y_c AND OPTIONAL DERIVATIVES THEREOF, AND A PLANT OUTPUT SIGNAL $\tilde{y}$ — S5

GENERATING A PSEUDO-CONTROL COMPONENT SIGNAL ν_{dc} BASED ON THE TRACKING ERROR SIGNAL $\tilde{y}$ — S6

GENERATING A TRANSFORMED SIGNAL $\tilde{y}_{ad}$ BASED ON TRACKING ERROR SIGNAL $\tilde{y}$ — S7

GENERATING AN R-TH DERIVATIVE OF COMMANDED OUTPUT SIGNAL $y_c^{(r)}$ — S8

GENERATING A SIGNAL $\tilde{y}_{ad}$ TO RENDER TRANSFER FUNCTION FROM ν_{ad} TO $\tilde{y}_{ad}$ TO BE STRICTLY POSITIVE REAL — S9

GENERATING A TRAINING SIGNAL δ BY FILTERING BASIS FUNCTION(S) ϕ AND MULTIPLYING THE FILTERED BASIS FUNCTION(S) ϕ BY TRANSFORMED SIGNAL $\tilde{y}_{ad}$ — S10

UPDATING CONNECTION WEIGHTS W OF A NEURAL NETWORK IN A BOUNDED MANNER BASED ON THE TRAINING SIGNAL δ — S11

GENERATING DELAYED VERSIONS OF PSEUDO-CONTROL SIGNAL ν — S12

GENERATING DELAYED VERSIONS OF PLANT OUTPUT SIGNAL y — S13

GENERATING THE ADAPTIVE CONTROL SIGNAL ν_{ad} BASED ON PSEUDO-CONTROL SIGNAL n AND DELAYED VALUES ν_d, PLANT OUTPUT SIGNAL y AND DELAYED VALUES y_d, AND CONNECTION WEIGHT(S) W, V AND BASIS FUNCTION(S) ϕ UPDATED BASED ON TRACKING ERROR SIGNAL δ — S14

GENERATING A PSEUDO-CONTROL SIGNAL ν BASED ON R-TH TIME-DERIVATIVE OF COMMANDED OUTPUT SIGNAL $y_c^{(r)}$, PSEUDO-CONTROL COMPONENT SIGNAL ν_{dc}, AND ADAPTIVE CONTROL SIGNAL ν_{ad} — S15
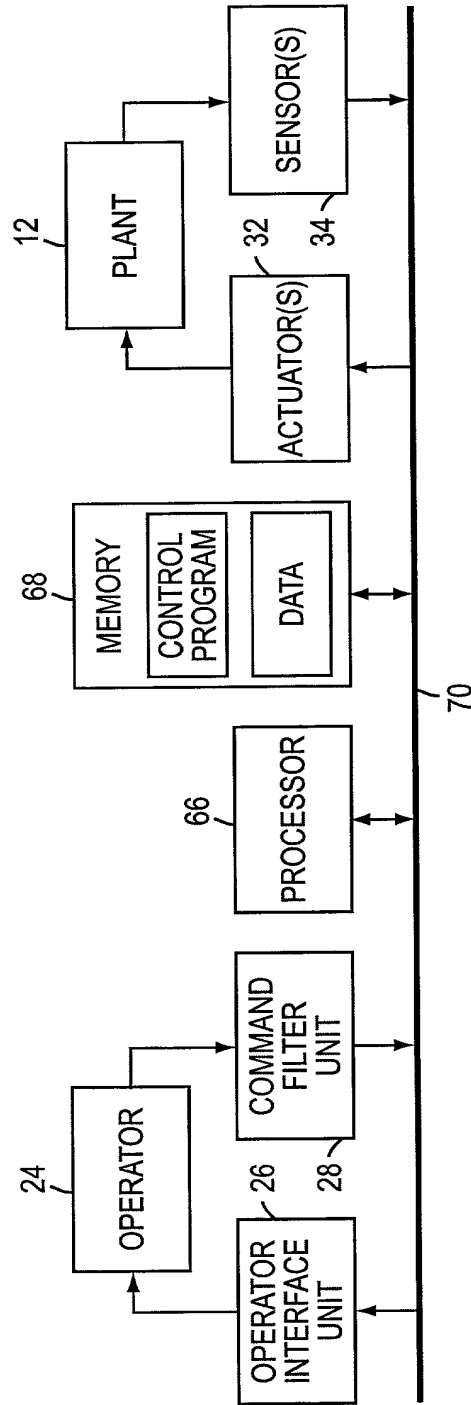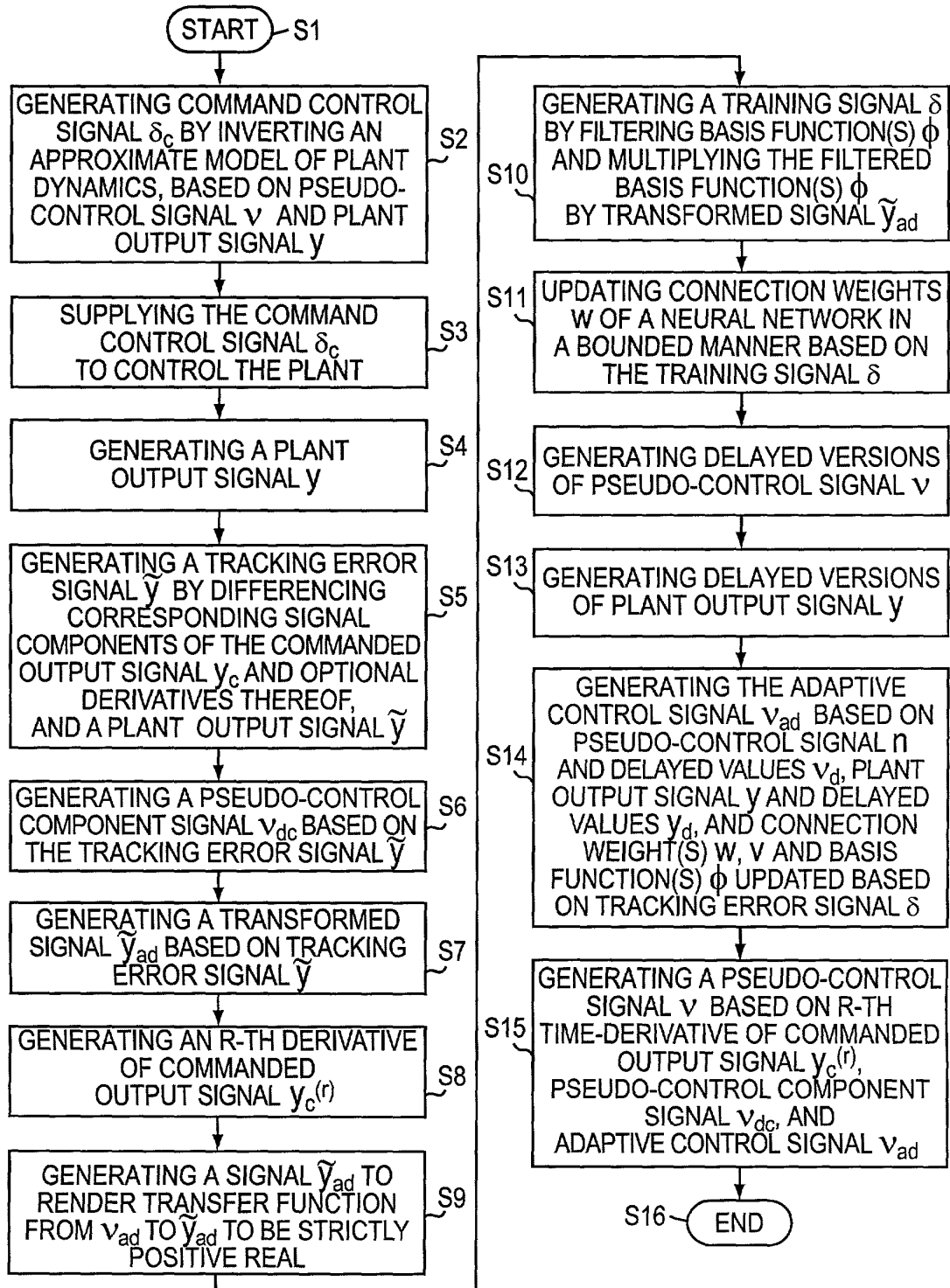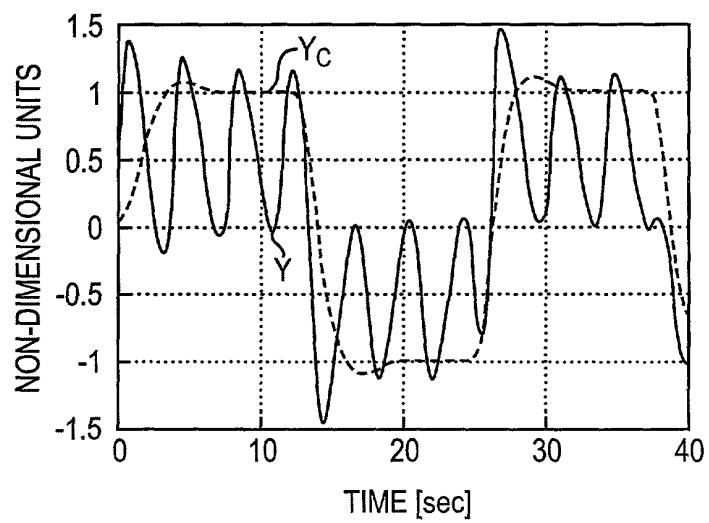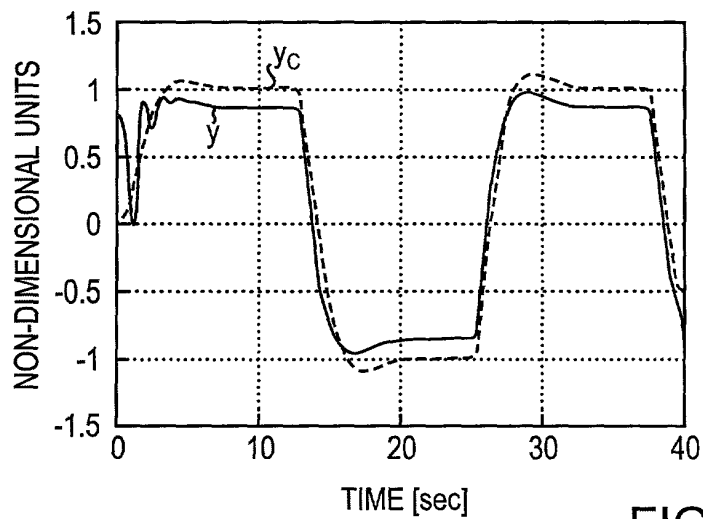
S16 — END

FIG. 6

SYSTEM WITHOUT UNMODELLED DYNAMICS:
RESPONSE WITH LINEAR COMPENSATOR

FIG. 7

SYSTEM WITHOUT UNMODELLED DYNAMICS AND NN CONTROLLER

(a) SYSTEM TRACKING

FIG. 8A
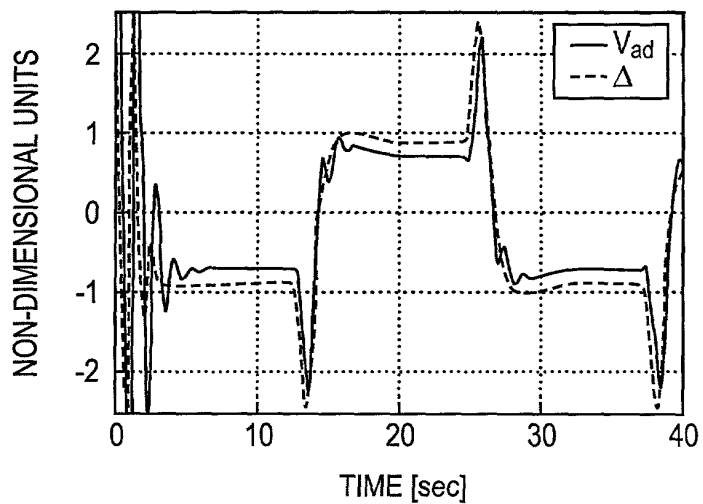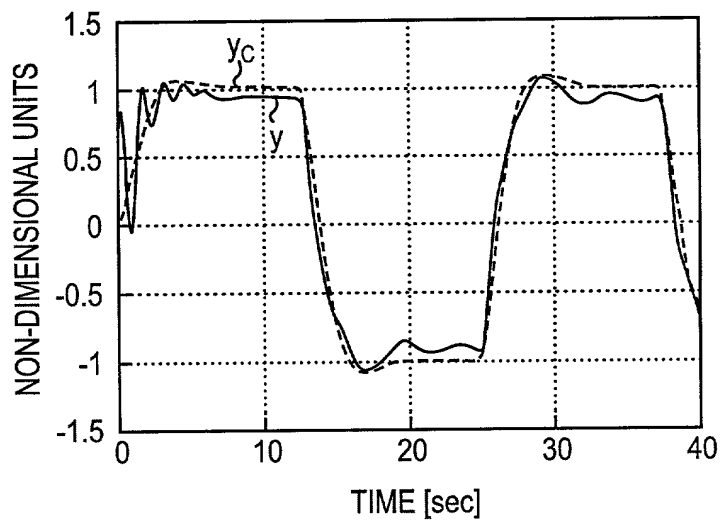

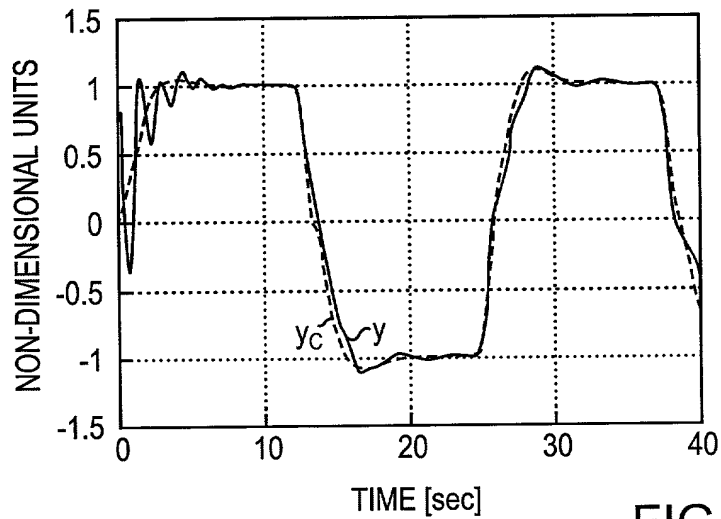(b) NN OUTPUT ν_{ad} AND INVERSION ERROR Δ

FIG. 8B

SYSTEM WITH UNMODELLED DYNAMICS:
RESPONSE WITH NN CONTROLLER

FIG. 9
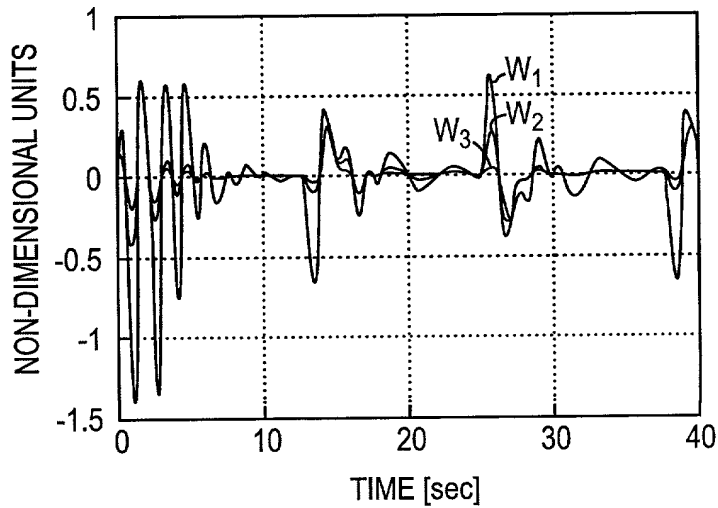
SYSTEM WITH UNMODELLED DYNAMICS:
RESPONSE WITH NN CONTROLLER AND LINEAR COMPENSATOR

(a) SYSTEM TRACKING

FIG. 10A

(b) NN WEIGHT HISTORY

FIG. 10B